REMARKS

This paper is responsive to the Final Office Action dated November 19, 2004. Claims 1-43 were examined.

Interview Summary

Applicant appreciates the time taken by Aimee J. Li for the telephonic interview on 18 January 2005. The participants included Aimee J. Li and Steven R. Gilliam. The participants discussed arguments made in the previous response, dated 23 August 2004. Examiner Li indicated that some of the arguments were not considered in the Final Rejection dated 19 November 2004, and requested that the arguments be resubmitted with any possible clarification of the arguments.

Rejections under 35 U.S.C. §103

Claims 1, 2, 4-9, 25-31, and 36-39 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 4,584,640 issued to MacGregor (hereinafter "MacGregor") in view of U.S. Patent No. 6,128,710 issued to Greenspan et al (hereinafter "Greenspan"), and in view of U.S. Patent No. 5,081,572 issued to Arnold (hereinafter "Arnold"). Claim 3 is rejected under 35 U.S.C. §103(a) as being unpatentable over MacGregor in view of Greenspan in view of Arnold as applied to claim 1 above, and further in view of Mark Allen Weiss's Data Structures and Algorithm Analysis in C++ Second Edition © 1999 (hereinafter "Weiss"). Claims 10-16 and 20-24 are rejected under 35 U.S.C. §103(a) as being unpatentable over Arnold in view of Greenspan. Claims 17-19 are rejected under 35 U.S.C. §103(a) as being unpatentable over Arnold in view of Greenspan as applied to claim 15 above, and further in view of MacGregor. Claims 32, 35, 40 and 42 are rejected under 35 U.S.C. §103(a) as being unpatentable over MacGregor in view of Greenspan, and in view of Weiss. Claims 33-34 and 41 are rejected under 35 U.S.C. §103(a) as being unpatentable over MacGregor in view of Greenspan and in view of Weiss as applied to claim 32 above, and further in view of Arnold. Claim 43 is rejected under 35 U.S.C. §103(a) as being unpatentable over Arnold in view of Greenspan, and in view of Weiss. Applicant respectfully traverses all of these rejections.

The rejection of Applicant's claims cannot stand because:

1) all of the rejections rely on an erroneous assertion regarding Arnold's disclosure, and
2) any combination of the art of record still fails to disclose or suggest an atomic dual target compare and swap that
    a) updates an end-identifying index,
    b) updates an element of a shared data structure corresponding to the end-identifying index, and
    c) facilitates detection of a boundary condition state.

Applicant submitted arguments edifying the above contentions in the previous response, and resubmits those arguments with some elaboration.

In the previous response dated 23 August 2004, Applicant essentially argued that Arnold did not disclose or suggest a dual target compare and swap operation that provided an indication by which a boundary condition state, whether empty or full, was detectable. In the rejection, the Office states that "Arnold has taught returning from the DCAS, on failure thereof, an indication by which an empty state of the array is detectable." Every rejection relies on this assertion by the Office, but this assertion is not supported by Arnold. Arnold discloses a CSD instruction and a CAL instruction, and discloses checking for an empty state. However, the check for empty state is separate from the instructions disclosed by Arnold. This can be seen in Figures 4A, 4B, 6 and 8 of Arnold. In each of these figures, the instruction, whether the CAL instruction or the CSD instruction, is performed separate from a determination of whether the stack or queue is empty. The following argument presented in the previous response emphasizes how this separation of operations as disclosed by Arnold allows a second thread to intervene, which is prevented by Applicant's claimed invention.

> Arnold performs a check for empty state separate from these atomic operations. The compare and load operation in Arnold is performed subsequent to the check for an empty state (Figs. 4A, 6, and 8). Arnold's technique allows a second thread of control to intervene after checking for an empty state, but before Arnold's compare and load is performed. (page 13 - 14 of response dated 23 August 2004)

The Office states that the prevention of a second interfering thread was not claimed. However, the subject matter of Applicant's claims prevents a second intervening thread. This same issue was further argued as follows:

> The boundary condition state detection and the accessing of the data structure are constituent aspects of the atomic multi-target compare and swap, thus addressing challenges presented in environments with multiple threads of control. (page 14 of the response dated 23 August 2004)

It is clear from the arguments presented above and previously that Arnold does not disclose subject matter as asserted by the Office, and thus, all of the rejections, which rely on Arnold, must fall. Hence, none of the art of record discloses or suggests at least the following limitations:

Claim 1 (similarly recited in claim 6 for a full state)

executing...an atomic dual target compare and swap operation (DCAS) to update...and returning from the DCAS, on failure thereof, an indication by which an empty state of the array is detectable

Claim 10

the second multi-way compare and swap performing the access and, on failure thereof, returning an indication disambiguating a retry state and the boundary condition state of the double-ended data structure

Claim 25

if successful completion of one of the first and the second competing access operations results in a boundary condition state of the array, the DCAS of the other of the first and the second access operations fails and returns an indication thereof

Claim 33 (similarly recited in claim 34 for empty state)

on failure, the DCAS returns an indication by which a full state of the contiguous array is detected

Claim 36

the push operation employs a first instance of an atomic dual target compare and swap (DCAS) operation to update one of the opposing indices and a corresponding element of the contiguous array while returning on failure, an indication by which a full state of the contiguous array is detected.

Claims 25 and 26 – 31 further emphasize the utilization of Applicant's invention in a parallel system with recitation of competing operations utilizing the atomic multi-target compare and swap operation for accessing an array and receiving indication of boundary condition states for the array.

With regard to claim 32, the Office Action never identifies art that discloses or suggests "a contiguous array S...a left index L and a right index R into the contiguous array...wherein at least the S[L] and S[R] entries encode a distinguishing value" as recited in claim 32.

With regard to claim 40, as previously stated, the art of record does not disclose or suggest "at least one functional sequence implementing an access operation on a concurrent shared object...instances of the at least one functional sequence concurrently executable by plural processors of a multiprocessor." The art of record discloses operations for singly linked lists and doubly linked lists, but does not evince techniques for accessing a concurrent shared object. The absence of a disclosure or suggestion related to a concurrent shared object is reinforced with the separation of atomic operations and checking of the boundary condition state in Arnold as previously discussed above.

With regard to claim 43, none of the art of record discloses or suggests "at least one atomic dual target compare and swap (DCAS) operation to disambiguate a retry state and a boundary condition state of the array" as recited in claim 43. Again, the art of record does not disclose or suggest utilizing a DCAS to determine whether a DCAS failed because of the boundary condition state of the array. The art of record determines the state of the array separate from access operations, and does not address "coordinating competing access operations."

None of the art of record discloses or suggests Applicant's claims, and especially does not disclose or suggest Applicant's independent claims. For at least the reasons given above, all of Applicant's claims are allowable over the art of record. Furthermore, Applicant's dependent claims are at least allowable for the reasons above and because they depend from corresponding ones of the above allowable independent claims.

Conclusion

In summary, claims 1 – 43 are in the case. All claims are believed to be allowable over the art of record, and a Notice of Allowance to that effect is respectfully solicited. Nonetheless, if any issues remain that could be more efficiently handled by telephone, the Examiner is requested to call the undersigned at the number listed below.

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Steven R. Gilliam — 19-Jan-2005 (Date)

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Respectfully submitted,

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